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AND ABSTRACT OF THE LITERATURE

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The Trend of Occupational Mortality in the United States

Pulmonary Asbestosis in its Clinical Aspects

Report of a Case of Injury to the Skin and Eyes by Liquid Sulphur Dioxide

Health Hazards in the Cotton Industry
(Concluded)

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THE TREND OF OCCUPATIONAL MORTALITY IN THE UNITED STATES*

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IN THE past two decades profound changes have occurred in the mortality tables of the general population. This is shown in official publications and in unofficial publications of insurance companies. We know this for the population as a whole but we do not know it for certain groups of the population. This paper discusses the trend of mortality among occupied persons and attempts to show that occupied persons have shared with the general population in the advantages and disadvantages of the shifting death rates.

In England the Registrar-General has been able to publish at decennial intervals tables of deaths and death rates among occupied males which appear to be reasonably reliable, but in the United States the Bureau of the Census has not considered its data accurate enough to warrant the publication of rates. It has published actual numbers only, and not even these recently. The latest official publication of occupational deaths refers to the mortality experience of 1909 (1). The Bureau of Labor Statistics (2), however, in 1917 published the occupational mortality of the Metropolitan Life Insurance Company for the years 1911 to 1913, inclusive, and these are the latest figures available.

It has been felt in the United States that if occupational death rates were to be published they would be more misleading than helpful for several reasons: (1) No accurate record of the number of persons engaged in the various occupations is available. (2) One cannot be sure that the occupation

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at death was the one pursued through the greater part of the worker's lifetime—a person does not stick to his trade in the United States so rigidly as he does in Europe (3). (3) A person may be recorded as unoccupied at death and yet may have pursued some definite occupation during the greater part of his lifetime.

Through the courtesy of Dr. Guilfoy of the New York City Health Department access was had to the New York mortality records for 1924. In dealing with the New York figures, however, additional difficulties arose to make the calculation of rates unreliable. In the first place the classification of occupations used by New York City was not the same as that used by the United States Census Bureau in its enumeration of the occupied in 1920. New York City describes sixty-seven occupations; the Census Bureau, nearly ten times that number. In the second place the classification of deaths was made by a different authority from the one used for the classification of the living; and, finally, the deaths and lives were not strictly comparable for they referred to different years—the one to 1924, the other to 1920.

These difficulties have made the death rates obtained obviously fallacious. We find, for example, that the death rate among occupied persons in New York City at ages 15 years and over was less than the death rate among the unoccupied (11.3 per thousand and 17.9 per thousand, respectively). These rates do not of themselves indicate inaccurate data for it might be that among the unoccupied were those who were physically handicapped and who had, therefore, a higher death rate. If we consider occupational groups separately, however, printers are found to have a very low death rate (6.8 per thousand), while policemen, who are thought to be as a whole very healthy individuals, have a very high death rate (21.8 per thousand). Other death rates are also found to vary considerably from what is reasonable.

Recourse has been had, therefore, to the device of proportionate mortality in order to compare occupations with each other. By this method one calculates what percentage the deaths of each disease or group of diseases are of the total deaths. There are obvious fallacies in this procedure. If 10 per cent. of the deaths in one occupation and 15 per cent. in another are due to tuberculosis, one cannot assume for certain that the former has a lower incidence of tuberculosis. It might be that it had a very high gross death rate and an average tuberculosis incidence. This would result in a low proportionate mortality. Again the age distribution of an occupational group may determine to a considerable extent its proportionate mortality from tuberculosis. We find, for example, that clerical workers have a high death rate from tuberculosis. This may be due to an unusual distribution of the occupied in the age groups particularly associated with high death rates for tuberculosis. In spite of these considerations, however, Collis and Greenwood (4) have found the correlation between proportionate mortality and death rates to be high; for phthisis at ages 35 to 45 in the Registrar-General's occupation groups it is $+0.754$ (± 0.04).

Table 1 gives the proportionate mortality from various grouped causes

TABLE 1.—PROPORTIONATE MORTALITY FROM PRINCIPAL DISEASES AMONG TEN OCCUPATIONS: NEW YORK CITY (1924, ALL AGES); METROPOLITAN LIFE INSURANCE COMPANY WHITE MALE POLICYHOLDERS (1911 TO 1913, 15 YEARS OF AGE AND OVER); MALES, UNITED STATES (1909, AGES 25 TO 64)

DISEASE	OCCUPATION										
	Clerical	Bricklayers	Painters	Printers	Tailors	Plumbers and Steamfitters	Carpenters	Cigar Makers	Butchers	Shoemakers	Total
Tuberculosis of lungs:											
N. Y. C.	17.0	8.5[1]	12.1	14.9	7.0	10.0	9.1	11.8[1]	6.8[1]	7.9	12.3
M. L. I.	35.0	19.0	21.9	34.1	...	31.6	...	24.1	....	....	28.4
U. S.	27.8	19.5	21.7	31.1	23.4	30.7	15.1	....	19.0	19.9	24.5
Cancer:											
N. Y. C.	9.3	4.8[1]	7.2	8.9	13.9	8.8	14.2	14.1	12.3	12.6	10.7
M. L. I.	3.1	6.5	4.1	2.7	...	2.8	...	5.2	....	....	3.9
U. S.	4.3	6.8	4.7	5.2	7.1	3.5	7.1	....	6.8	4.4	5.9
Apoplexy and paralysis:											
N. Y. C.	3.1	1.2[1]	3.6	5.6[1]	4.4	2.7[1]	4.4	2.3[1]	2.4[1]	6.1[1]	3.7
M. L. I.	3.9	7.8	7.6	3.6	...	5.1	...	6.5	....	....	5.6
U. S.	4.6	5.2	6.1	5.1	4.5	4.6	6.4	....	5.3	7.0	5.9
Heart disease:											
N. Y. C.	22.0	24.2[1]	21.8	22.5	30.9	23.3	22.9	28.8	33.6	26.2	24.5
M. L. I.	9.4	13.0	10.7	11.2	...	9.2	...	11.7	....	....	10.5
U. S.	9.3	11.1	9.2	8.5	9.4	9.2	11.3	....	10.6	10.9	10.7
Pneumonia:											
N. Y. C.	10.2	13.9[1]	10.6	6.6	9.9	12.8	10.6	5.3[1]	8.9	10.8	10.1
M. L. I.	7.1	7.6	6.1	4.9	...	6.5	...	4.6	....	....	6.5
U. S.	7.8	9.0	7.9	7.5	7.6	10.1	8.0	....	7.7	8.7	8.7
Bright's disease:											
N. Y. C.	5.2	4.8[1]	5.2	6.3	5.5	5.1[1]	5.7	6.5[1]	4.8[1]	5.7[1]	5.4
M. L. I.	7.4	10.2	12.2	8.9	...	10.0	...	10.1	....	....	9.5
U. S.	8.9	8.3	12.2	8.1	9.8	6.2	8.0	....	9.7	11.0	9.9
Accidents[2]:											
N. Y. C.	8.7	19.4[1]	13.5	11.3	4.8	12.8	9.2	8.8[1]	9.6	7.6	9.2
M. L. I.	7.2	7.6	8.7	5.9	...	8.8	...	4.6	....	....	7.5
U. S.	4.4	12.0	11.2	5.2	4.7	10.0	12.6	....	6.5	5.5	8.7
Totals:											
N. Y. C.	2,362	165	555	302	923	296	790	170	292	279	...
M. L. I.	4,139	1,748	2,722	1,056	...	1,153	...	693	....	....	...
U. S.	6,189	1,465	2,802	1,052	1,558	938	4,316	....	1,137	1,311	...

[1] Represents less than 20 deaths.

[2] In Metropolitan Life Insurance figures homicide is not included as cause of accidental death.

of death in several occupations in New York City (1924); among the Metropolitan Life Insurance Company white male policyholders (1911 to 1913); and in the United States (1909). The Metropolitan Life Insurance figures correspond remarkably well with those of the United States, but the New York City figures show rather marked divergences, notably in tuberculosis, cancer, and heart disease. If these data be compared with those of Table 2, in which the proportionate mortality for the United States as a whole in 1909 is compared with that of 1923, it will be seen that a similar change has occurred in causes of death among occupied males and in the general population.

TABLE 2.—DEATHS AND PROPORTIONATE MORTALITY FROM VARIOUS CAUSES AT 10 YEARS OF AGE AND OVER: UNITED STATES REGISTRATION AREA (1909) AND UNITED STATES REGISTRATION STATES (1923)

CAUSE	MALE AND FEMALE				MALE				FEMALE			
	1909		1923		1909		1923		1909		1923	
	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality
Tuberculosis of lungs	67,522	13.0	75,766	8.2	38,132	13.5	40,015	8.3	29,390	12.4	35,751	8.2
Cancer	37,321	7.2	85,048	9.2	14,787	5.2	37,170	7.7	22,534	9.5	47,878	11.0
Apoplexy and paralysis	44,377	8.5	91,800	10.0	22,507	8.0	45,127	10.1	21,870	9.2	46,673	10.7
Heart disease	71,272	13.7	155,402	16.9	37,639	13.3	80,778	16.7	33,633	14.2	74,624	17.1
Pneumonia	39,108	7.5	67,011	7.3	21,507	7.6	36,259	7.5	17,601	7.4	30,752	7.1
Bright's disease	46,560	9.0	84,624	9.2	26,144	9.3	44,644	9.2	20,416	8.6	39,980	9.2
Accidents	36,610	7.0	67,390	7.3	29,691	10.5	51,345	10.6	6,919	2.9	16,045	3.7
All other causes	177,092	34.1	293,396	31.9	91,717	32.5	149,353	30.8	85,375	35.9	144,043	33.1
Totals	519,862	....	920,437	....	282,124	....	484,691	....	237,738	....	435,746	....

Table 3 gives the number of deaths and the proportionate mortality for various diseases among all occupied males, in the United States (1909); among the Metropolitan Life Insurance Company white male policyholders (1911 to 1913); and among occupied males, United States (1920) (5). The New York figures are not included in this table. The 1920 figures are possibly somewhat distorted by the influenza deaths. There were 19,554 deaths from influenza in 1920, nearly 10 per cent. of the total. This high death rate would tend to depress the proportionate mortality in all the groups of diseases under consideration, for influenza did not spare any particular class of persons or group of diseases. It would not be reasonable to attribute the low proportionate mor-

tality from tuberculosis in that year to the influenza epidemic for, although the general death rate from tuberculosis was somewhat lower in 1920 than in 1919, it was lower also in 1921 than in 1920, and in 1918, the year of the great influenza epidemic, the death rate from tuberculosis was higher than in any of the preceding or succeeding five years.

TABLE 3.—DEATHS AMONG OCCUPIED MALES, UNITED STATES (1909, 10 YEARS OF AGE AND OVER); METROPOLITAN LIFE INSURANCE WHITE MALE POLICYHOLDERS (1911 TO 1913, 15 YEARS OF AGE AND OVER); OCCUPIED MALES, UNITED STATES (1920, 10 YEARS OF AGE AND OVER)

CAUSE	U. S. (1909)		M. L. I. (1911–1913)		U. S. (1920)	
	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality
Tuberculosis of lungs	31,059	14.8	19,349	20.5	38,397	11.3
Cancer	11,536	5.5	4,578	4.9	23,959	7.0
Apoplexy and paralysis	15,409	7.3	5,825	6.2	25,718	7.5
Heart disease	25,043	11.9	11,323	12.0	44,598	13.1
Pneumonia	16,866	8.0	6,776	7.2	34,104	10.0
Bright's disease	17,888	8.5	9,059	9.6	29,538	8.7
Accidents	22,201	10.5	8,752	9.3	34,193	10.0
All other causes	70,505	33.5	28,607	30.3	110,259	32.4
Totals	210,507	.....	94,269	.....	340,766	.....

TABLE 4.—DEATHS AND DEATH RATES PER THOUSAND BY AGE AND SEX: ALL OCCUPIED PERSONS IN NEW YORK CITY (1924) AND ALL PERSONS IN THE UNITED STATES REGISTRATION STATES (1923)

AGES	MALE				FEMALE			
	Deaths		Death Rate		Deaths		Death Rate	
	N. Y. C. (1924)	U. S. (1923)	N. Y. C. (1924)	U. S. (1923)	N. Y. C. (1924)	U. S. (1923)	N. Y. C. (1924)	U. S. (1923)
15–19	414	13,327	2.7	3.6	227	13,248	1.5	3.5
20–24	973	16,962	4.1	4.7	340	17,567	2.0	4.5
25–44	6,946	88,786	7.2	6.4	957	78,323	3.4	5.9
45–64	11,273	145,362	26.2	17.8	1,061	114,256	12.2	15.8
65 and over	5,805	184,126	127.8	83.3	594	180,503	74.3	80.6

Table 4 gives the death rates by age and sex for all occupied persons in New York City (1924) and for the United States registration states (1923)—the latest figures available. These rates for occupied persons are given for what they are worth, which is probably very little, for the reasons already stated.

Table 5 gives the number of deaths

and the proportionate mortality by age for occupied males, United States (1909); for the Metropolitan Life Insurance Company white male policyholders (1911 to 1913); for occupied males, United States (1920); and for all occupied males, New York City (1924).

TABLE 5.—DEATHS AND PROPORTIONATE MORTALITY FROM ALL CAUSES, BY AGE: OCCUPIED MALES, UNITED STATES (1909); METROPOLITAN LIFE INSURANCE COMPANY WHITE MALE POLICYHOLDERS (1911 TO 1913); OCCUPIED MALES, UNITED STATES (1920); AND OCCUPIED MALES, NEW YORK CITY (1924)

POPULATION GROUP	AGE PERIOD								TOTAL
	15–24		25–44		45–64		65 and over		
	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	Deaths	Proportionate Mortality	
U. S. (1909)	17,553	8.6	61,096	29.9	71,664	35.0	54,264	26.5	204,577
M. L. I. (1911-1913)	11,116	11.8	28,195	29.9	35,831	38.0	19,127	20.3	94,269
U. S. (1920)	25,591	7.6	90,811	26.8	117,056	34.6	104,728	31.0	338,186
N. Y. C. (1924)	1,219	5.1	6,265	26.0	10,842	45.1	5,709	23.8	24,035
Totals	55,479	8.4	186,367	28.2	235,393	35.6	183,828	27.8	661,067

It will be noted that age distribution of deaths has varied very little during the period under review except in the case of New York City. It is probable that New York City is not strictly comparable to the country as a whole with respect to the age distribution of occupied persons; the excess of deaths at ages 45 to 64, therefore, cannot be interpreted in itself as indicating an excessive occupational mortality. The United States Census of 1920 showed that 52.8 per cent. of occupied males in New York City were in the age group 25 to 44, whereas in the country as a whole only 43.5 per cent. of occupied males were in this age group. A large number of persons in the age group 25 to 44 should mean a large number of deaths in that age group, but it might mean that a large number of persons in that group are incapacitated from work and do not die until they reach the next age group. Of 100 men in age group 25 to 44, thirty might become incapacitated and be recorded by the Census as unoccupied, whereas, when they die between the ages 45 and 64, the death certificates would record them as having been occupied. This is probably a fanciful interpretation but it is not an impossible one. It indicates at least the care that should be taken in the interpretation of such figures.

Discussion

It is evident from a study of these figures that our conception of industrial mortality must change somewhat. The prevailing idea that tuberculosis is

still the leading cause of death among industrial workers, whereas it has taken third or fourth place as a cause of death in the general population, is apparently incorrect. Tuberculosis is still excessive in industry as compared with the country as a whole but it is now surpassed in importance by cardiac diseases. No longer is tuberculosis the "captain of the men of death."

This study does not support the idea that the increase in cancer is due to increasing industrialization. Indeed the relative proportion of cancer among occupied persons is actually less than among the unoccupied. This, of course, may be accounted for if one supposes that a number of cancer patients stop work some time before death and are recorded on the death certificates as unoccupied. The increase in proportionate mortality from cancer among occupied persons, however, is no greater than that among the general population.

The reason for the increase in proportionate mortality from heart disease is due, not so much to an actual increase in deaths from the disease, as to a decrease in death from other diseases, chiefly tuberculosis. The death rate from heart disease has increased somewhat in the general population but not to the extent suggested by the increase in proportionate mortality.

The age distribution of deaths from tuberculosis and heart disease for occupied persons in the United States in 1909 and 1920 is given in Figures 1 and 2. These charts are of interest in showing that there has been a shifting in deaths from these diseases to the later years.

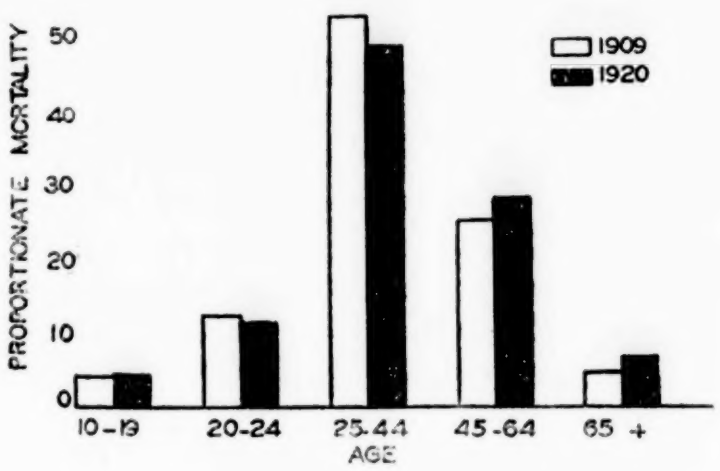

FIG. 1.—Proportionate mortality from tuberculosis, by age, among occupied males in the United States, 1909 and 1920.

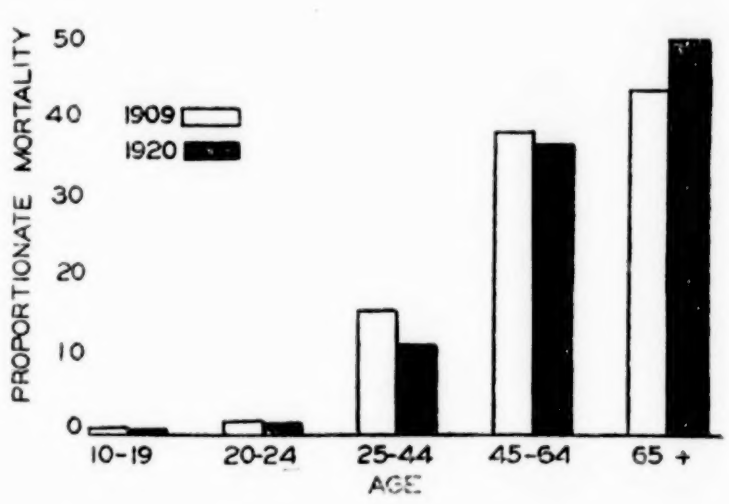

FIG. 2.—Proportionate mortality from organic diseases of the heart, by age, among occupied males in the United States, 1909 and 1920.

Apoplexy and paralysis and the chronic diseases of the kidneys show very little change in their proportionate mortality among occupied persons in the last decade, nor do they show much change in the general population. If hidden foci of infection are responsible in part for the development of these diseases, the active crusade directed toward the elimination of these foci should soon be reflected in the mortality records.

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PULMONARY ASBESTOSIS IN ITS CLINICAL ASPECTS*

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A SHORT account of the history of asbestos, and also of the processes of its manufacture into cloth-like structures much in the same manner as raw cotton fiber is woven, has been written by Dr. W. E. Cooke. He has told us that in the carding department a considerable quantity of dust is evolved. The crushing of the rock is not carried on to any extent in Great Britain. This is usually done in the countries where the mineral is quarried. Canadian rock is crushed in Canada, so as to reduce the expense of transport to Great Britain. British workers are therefore less exposed to the harmful influence of the dust, a fortunate circumstance since the rock frequently contains (according to chemical analysis) as much as from 50 to 60 per cent. or more of silica in the form of silicate of magnesia.

With the exception of Dr. Cooke's paper on pulmonary asbestosis, published in 1924, and the details of a fatal case published by Dr. Montague Murray in the *Charing Cross Hospital Gazette* in 1900, there has not been anything written, to my knowledge, in Great Britain upon the subject. I have had, however, the opportunity of visiting asbestos factories in America and of seeing cases of pulmonary asbestosis through the kindness of Dr. Haddow and Dr. Grieve of Armley, Leeds. It may, I think, be shrewdly suspected that there have been several deaths of workers in British factories from the malady, but as no autopsy or microscopic examinations of the lungs have been made, such deaths would probably be certified as pulmonary tuberculosis.

Since these lines were written, I have in August last visited the asbestos mines in Thetford, Canada. The material is obtained by blasting in the open quarry the hard rock, when, adherent to portions of it, may be seen the silken fibers of the mineral. The broken rock is subsequently crushed, recrushed, screened, and pulverized to sand. The finely crushed product is thereafter passed over vibrating machinery when the liberated asbestos fibers are aspirated by vacuum fans into chambers and retained. The sand is useless and goes to form the huge white dumps which are disfiguring objects of the landscape in an asbestos mining district. The finer crushing and screening are dusty processes.

Asbestos manufacture is largely a familial occupation. It has been carried on in England only for a little over thirty years. Carding and spinning of the fiber are important processes in the manufacture of asbestos

* Read in the Section of Preventive Medicine, British Medical Association Meeting, Edinburgh, July 21, 1927. Received for publication July 26, 1927.

goods. In these departments many women are employed, mothers being succeeded by their daughters. Where ventilation of the carding and spinning rooms is properly attended to, the atmosphere is fairly clear of dust and floating fiber; otherwise in these operations considerable quantities of dust become suspended in the atmosphere. In a British factory the dustiest process is "hand beating" of the finished mattresses which are used for covering and protecting the internal machinery of automobiles. This work should only be undertaken in a room separated from the main parts of the factory, with open windows at one end and strong down drafts at the other; but even with this precaution men working therein should wear masks.

Recently, along with Dr. Grieve of Armley, I examined two women, subjects of pulmonary asbestosis—one is aged 48 and the other 39. The older patient was one of the first to commence work thirty years ago in the particular factory that I visited. At that date no danger from dust was anticipated, so that no effective ventilation of the workrooms was attempted, such as prevails today. Although only 48 years of age, the first patient mentioned looks older by several years and is extremely emaciated. She gave up work a year ago on account of increasing physical debility, shortness of breath, and cough. At present she has no expectoration; her respiratory capacity is 1 inch. Although the apices of both lungs in front are resonant, there is distinct flattening of the percussion note at the bases. The respiratory murmur at the apices and mid-lung is coarser than usual, and the expiratory murmur is prolonged. At the right base the respiratory murmur is feeble, and small dry friction sound is heard. Toward the base of the left lung and extending into the axilla are heard small, moist tinkling sounds, suggestive of cavitation having taken place. Here also small friction sounds are heard. Similar physical signs prevail posteriorly. The apex beat of the heart is displaced upward and outward; it is felt external to the nipple, a circumstance which along with marked accentuation of the second sound of the heart heard over the pulmonary artery suggests that fibrotic changes have already taken place in this lung. Although the patient states that she has no expectoration, this was present six weeks ago and when examined it was found to be free of tubercle bacilli. There is no enlargement of the external glands.

The other patient, aged 39, has been an asbestos worker for eighteen years. She had no illness until four years ago, when she developed cough and attacks resembling bronchial asthma. After remaining away from the factory for three months she returned to her employment and followed the occupation for three years, when she married. As in the early months of her pregnancy she lost considerably in weight, she retired from the factory. Although she was reduced considerably in weight, and the subject of cough all through the pregnancy, her infant daughter who is 14 months old is healthy and well developed.

The patient complains of a dragging in the chest without actual pain. There is noticeable shortness of breath

on slight exertion and she complains of morning cough with expectoration. The sputum has been examined and is negative for tubercle bacilli. Her appetite is poor. She weighs 8 stones, a drop of 3 stones having occurred within the last two years. Her heart is healthy; the apex beat is not displaced, but the second sound over the pulmonary artery is distinctly accentuated. The apices of the lungs are resonant. Here the respiratory murmur is coarser than usual and the expiratory is prolonged so that the inspiratory and expiratory murmurs approach each other in equality. Moist râles are heard in midaxillae and small friction with crepitation is heard at the bases. This patient's mother, aged 60, is still working in the factory.

From what I have seen clinically of pulmonary asbestosis it resembles silicosis of the lungs in pronounced shortness of breath on slight exertion, in deficient respiratory capacity, in physical debility and, on examination of the sputa of not too far advanced cases, in the absence of tubercle bacilli; but, since fibrotic changes are taking place in the lungs of both patients, the possibility has to be envisaged of the development, if such has not already taken place, of pulmonary tuberculosis.

The clinical picture of pulmonary asbestosis differs slightly from that presented by a patient who is the subject of ordinary tuberculosis of the lungs in so far as there is a noticeable darkening of the skin varying from mild bronzing to slight blueness, a degree of shortness of breath in excess of the physical signs, a greater amount of general disability, little expectoration, and comparative absence of night sweats.

REPORT OF A CASE OF INJURY TO THE SKIN AND EYES BY LIQUID SULPHUR DIOXIDE*

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THE recent and increasing use of household refrigerating plants may make the report of the following case of interest to the medical profession and to students of hygiene. I am informed that many of these household plants use liquid sulphur dioxide as the refrigerant. Inasmuch as the accident which I am about to report was caused by this chemical, I have tried to inform myself somewhat of its toxic effects.

A plant which manufactures liquid sulphur dioxide, for use in these household refrigerators, is located near me; I therefore took occasion to inspect it.

On entering the plant, which is largely open, there is a distinct odor of sulphur dioxide about as strong as if several sulphur matches had been burned in a small room. I looked over the employees who were constantly exposed to these fumes and made inquiries as to their health. They seem to be an unusually healthy set of workmen, and the superintendent stated that there had never been any impairment in their health, so that certainly in small quantities sulphur dioxide fumes are not deleterious. I had the men throw some of the liquid sulphur dioxide on the floors and thus allow it to evaporate rapidly. When the fumes were very strong there was considerable respiratory irritation. Should there be a break in any of the pipes containing this liquid, therefore, it would at once make itself manifest in the first place by the odor, which is, as every one knows, quite disagreeable, and, secondly, by marked respiratory irritation, should it be liberated in large quantities.

It has been erroneously stated that the addition of water to sulphur dioxide causes the formation of sulphuric acid (H_2SO_4), whereas the acid produced is sulphurous (H_2SO_3). Sulphurous acid has been used for many years in the arts, especially in bleaching, and does not cause more than a roughness of the skin on exposure of the hands to it.

My belief is that sulphur dioxide is not poisonous under any ordinary circumstances, from the facts of the following case:

Louis M., an employee of the Virginia Smelting Company, on Dec. 13, 1922, undertook to open a valve to a tank containing some 10 to 12 gallons of sulphur dioxide, using a pipe wrench, which broke the pipe leading to the tank, causing a forcible expulsion of the contents of the tank over his body and face. There was very little injury inflicted where his body was covered with clothing, but his face and eyes were injured. The effect was apparently as if hot water had been thrown on him causing injury of the skin of his face, of his eyelids, and of his nose. There was then considerable edema of the lids, especially of the right eye, with

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blistering of the skin of the lids and face. The cornea of the right eye was almost completely denuded of epithelium but the substantia propria was clear. There was marked conjunctival injection and chemosis and a burn of the conjunctiva adjoining the limbus above and extending upward and inward. In the left eye the injury was not so severe, the epithelium being absent in only the lower half of the cornea. The conjunctival injection in this eye was less marked than in the right. Both irides were hyperemic and there was considerable purulent discharge from both eyes. Under boric acid wash, atropine and oil instillations, the corneal epithelium was almost replaced at the end of nine days after the accident with vision equal to the counting of fingers.

After five weeks, vision in each eye was 20/100 with the corneal epithelium somewhat roughened and conjunctival injection almost gone. Four months after the accident, vision in each eye was 20/15 and the eyes had no appearance of having been injured.

At the present time, four years after the accident, this man shows no ill effects whatever either with regard to his eyes or his general health. My observations in this case give me the impression that the ill effects of exposure to liquid sulphur dioxide are due solely to a rapid freezing of the tissues and not to any escharotic action as is seen after accidents due to lime, ammonia, or other caustics.

HEALTH HAZARDS IN THE COTTON INDUSTRY

(Concluded)

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Infection

The early days of the cotton industry were marked by the occurrence of serious epidemics of smallpox, typhus, cholera, and typhoid, but it has not been suggested so far as I am aware that, even in those unhealthy times, the workrooms or processes themselves were responsible for the rapid spread of infection. Respecting the factories of today, we certainly know that there is no approach to overcrowding of workers, the air space provided per individual being usually over 1,000 cubic feet and reaching in some cases to 10,000 cubic feet. In the matter of proper spacing of the operatives, which is of course all-important, this is brought about automatically by the arrangement of the machines; and as micro-organisms do not float about promiscuously in the atmosphere, but are usually enclosed in fine droplets which are driven into the air from the respiratory passages of the infected and must be caught at short range to do any harm, the danger of any direct transmission of infection is at a minimum. As to vermin, head lice and fleas have every facility for changing their environment where garments are hung up in close proximity, and the latter can often be found in cotton waste and fluff. The introduction of sheet iron lockers should go far toward preventing these objectionable migrations.

Shuttle Kissing.—At the Annual Meeting of the British Medical Association, in 1902, Dr. Thomas Watts contributed a paper dealing with the risk of conveying infection through the practice of "shuttle kissing" among weavers, and, in 1910, Dr. John Brown, Medical Officer of Health of Bacup, issued a particularly strong report on the subject, which produced a great deal of comment in many newspapers. Mainly as a result of the great publicity given to Dr. Brown's report, a special conjoint committee was appointed by the Local Government Board and the Home Office with instructions to investigate the whole subject.

The practice of shuttle kissing has to do with the threading of the shuttle eye each time a fresh cop is placed in the shuttle. Inside the hollow of the shuttle is a jointed skewer which is pulled out at a right angle when the fresh cop is slipped on; from the latter a portion of the thread is unwound, and then is bunched and placed against the inside of the eye. The weaver

next places the outside of the eye to the lips and, with a strong inspiratory effort, draws the thread through; this constitutes the actual kissing. The action of inspiration is so powerful that any particles of dust, cotton, size, dye, and even disease germs, which happen to be in or near the eye, may be drawn through the air passages to the lungs. The report of the Committee (26) mentions that this action may be performed by a four-loom weaver as many as 400 or 500 times in a working day, and that, though each weaver has his or her own set of shuttles, any of these implements may receive an additional kiss from the tenter, the tackler, or even the overlooker.

Fifty-eight Lancashire medical officers of health sent in replies to a set of questions circulated by the county medical officer, and from these it was gathered that the diseases likely to be caused by this certainly objectionable practice were mainly syphilis, phthisis, diphtheria, caries of the teeth, skin diseases, septic throat, scarlet fever, and infective conditions of the mouth, but only five specific instances were given of actual transmission of disease. The instances covered cancer, tonsillitis, tuberculosis, phthisis, and scarlet fever; though every case mentioned was carefully investigated, the Committee, however, was unable to find any justification for debiting the shuttle with responsibility for the causation of any of these diseases (26). Evidence taken from a number of medical officers of health, certifying surgeons, and private practitioners did not produce much beyond differences of opinion. Two instances of syphilitic sores on the lips were cited, but there was no evidence of their transmission to others. The Dental Surgeons' Association, at the request of the Committee, appointed a subcommittee to investigate the alleged effects on the teeth, and the balance of evidence received supported the view that the teeth are damaged by the practice. It was also argued that caries probably starts before commencing work at weaving, and that habitual neglect to clean the teeth is a strong contributory cause of injury. The Committee considered that shuttle kissing is not so dangerous as it is supposed to be, and that the position may be fairly summed up in the words of a resolution adopted by my own branch of the Society of Medical Officers of Health: *viz.*, "That this branch is of opinion that the habit of 'shuttle kissing,' common in many districts in Lancashire, is objectionable and potentially dangerous to health, and thinks it desirable that means be taken by which the continuance of this practice may be rendered unnecessary."

The newspaper campaign of 1911 evidently stimulated invention, for a considerable number of devices for shuttle threading without kissing were soon on the market; a slanting slit communicating with the eye, arrangements for guiding or hooking the thread through the eye, and mechanical suckers being the main devices put forward. The Northrop loom, which has a mechanical shuttle threading arrangement, causes no trouble during weaving, and well supports the view that the general adoption of methods found to be practical would completely do away with the necessity for indulging in this exceedingly bad

habit. It would appear, however, that the practice is still so common that the Home Office has felt compelled to recommend the insertion of a prohibitive clause in the several Factory Bills that have been recently issued.

Weavers' Cough.—In certain dry sheds where the cloth woven is intended for bleaching, dyeing, or printing, the operatives under certain circumstances have been subjected to outbreaks of an unusual type of cough and dyspnea. Owing to a succession of these outbreaks in 1910, 1911, and 1912, an investigation into their nature and causation was made by Dr. E. L. Collis on behalf of the Home Office (27). This investigator found that the warps used for the purposes stated contained less than the ordinary amount of size, and that the usual antiseptic, zinc chloride, had been omitted because the dyer specified that the cloth must not contain chlorides. In addition it was ascertained that the warps in use at the time, owing to previous complaints of breakages, had not gone through the complete process of drying after sizing, and had developed mildew on being placed in the looms. In one large shed 500 looms were supplied with "dry taped" warps and 500 looms with "wet taped" warps, but only those weavers working at or near the latter were affected; the weft was the same for all the looms. A reversion to dry taping for all the warps cured the disease.

The symptoms appear to have been, in the first place, a feeling of constriction of the chest and dyspnea, this being followed by a persistent irritating cough, accompanied by expectoration of a yellow or greenish-yellow sputum and by a sweetish taste in the mouth. The dyspnea afterward takes on an asthmatic form, the coughing may produce vomiting or epistaxis, the fauces become inflamed, and flesh is lost. The temperature may rise to 102°F. in the evening, but is apparently normal during the day. Those with slight symptoms kept at work, but those with severe symptoms had to take to bed.

The effects are similar to those described as due to aspergillosis, and as, in each outbreak investigated, the presence of mildew was proved, it seems fairly certain that the causation should be attributed to mold. In order to prevent the development of mildew, and so allow of wet taping during hot and dry weather, formalin has been introduced as an antiseptic in place of the barred zinc chloride. Dr. Bridge (28) investigated an outbreak in 1924, and found the conditions and symptoms as described, but no further light was thrown on the nature of the mold causing the complaint. A further outbreak in 1925, which was investigated by Dr. Middleton (17, p. 79), proved to be of a similar nature to the others, the only fresh information provided being to the effect that the air, during the process of weaving, was laden with conidia, spores, and fragments of mycelium. Middleton thinks the effects may be produced by an increase in the number of particles of common molds, which in ordinary numbers are harmless, or by a specific organism, mold fungus or lower form of fungus, the actual occurrence or the conditions favoring development being rare.

Infected Cotton.—In certain out-

breaks of smallpox which have occurred in Lancashire cotton districts, during recent years, it has been suggested that the infection might have been conveyed by means of the cotton, the theory being that undetected mild cases of smallpox exist among the negro cotton pickers, and that as every tuft is handled in the picking some of them may become infected. The cotton is placed in a bag carried by the picker, who empties it, when it is full, into a larger bag which, in turn, is emptied along with others into a cart fitted with high sides; the total contents of the cart is well pressed down to make a good load. The cart takes the cotton to the gin, and it is only during this journey that it receives any exposure to sunlight and air, such exposure being limited to the top layer. After ginning, it is immediately compressed into bales. It is claimed that this exclusion of sun and air will tend to preserve the infection. These negro pickers work through the cotton fields, from south to north, until the season is over; then they return to their slummy and infected surroundings in the towns. As the type of smallpox prevalent in the southern part of the United States is mostly of a mild character, thus making it easy for "missed" cases to be at work, there may be something in this theory of infected cotton, but in view of our present ignorance of the exact nature and qualities of the infection itself one can scarcely say more.

The evidence in support of this channel of infection is equally weak on the Lancashire side, and mainly for the same reason. Some brief details of the outbreaks alluded to are contained in a Special Report by the Lancashire County Medical Officer of Health (29) dealing with an epidemic of smallpox in Middleton during the year 1920. The particular cases arose in the following towns: Stockport, March, 1908, 1 case, and February, 1909, 3 cases; Heywood, January, 1910, 7 cases; Colne, July, 1910, 1 case; Chadderton, November, 1910, 6 cases; Bury, March, 1911, 30 cases; Oldham, 1913, 8 cases; Milnrow, May, 1914, 11 cases. The primary infections were all among workers in cotton mills, and in none of them could any contact with older cases be traced. All worked with American cotton except the second Stockport group, and all were single infections except the cases in the Heywood and Milnrow outbreaks. At Heywood 2 strippers, who apparently worked together as a pair, developed the rash on the same day; at Milnrow the 11 patients all worked at one mill, all sickened between May 26 and May 29, the rash appeared in the majority of cases on May 30 or 31, and Mexican cotton had been used for the first time on May 14. The Heywood and Milnrow outbreaks certainly present some *prima facie* evidence that the cotton is at fault, the strength of the theory in the latter instances lying in the fact that all the different processes throughout the mill, with a single exception, claimed one or two victims, thus indicating that the infection, if present, traveled along with the cotton. The infection would be inhaled with the dust, and probably in the later processes during cleaning. Corbin of Stockport believed that the practice of moistening the fingers at the mouth before piecing was the

most likely method of introducing the infection.

If the Mexican cotton were to blame, it is not likely that more than a small portion of the consignment could have been infected. There would probably be only one infected bag emptied into a cart and, as the whole load would go through the gin in a batch and be baled without a great amount of mixing, it seems probable that any infection would be confined to one or two bales. On the supposition that the consignment contained one infected bale, the contents of this would also be kept fairly well together, allowing of course for mixing with other cotton, until after carding; and even after this process only those parts of the sliver and rover frames through which the cotton from the bale had passed would stand a chance of infecting the workers. Considering these circumstances and considering how quickly the cotton would get through the various departments, one would scarcely expect a larger number of primary cases from the particular mill.

One can only look at outbreaks of this nature as indicating a possibility of cotton infection. It is generally agreed that personal contact must be looked for when tracing the origin of the disease, and even where such cannot be proved there is a fair average certainty that it has taken place.

Sanitary Accommodation

It will be generally acknowledged that sufficient, suitable, and separate latrine or closet accommodation for both sexes is a necessity in all factories, and that if provision of this kind is not made and maintained on strictly sanitary lines a nuisance must necessarily arise.

To the best of my knowledge, every Lancashire cotton district is provided with a good, high pressure public water supply, and practically every one of them is served by well-designed drains and sewers; there is also no question that the English sanitary laws are good. In spite of these undoubted facts, this class of accommodation appears to be of a very insanitary type in quite a large number of cotton factories. This is partly due to double control. As local governing authorities are the owners of the sewers, and usually either the owners or the lessees of the water supply, it would seem that they have, quite properly, been given control of the provision of sanitary conveniences for factories as well as for houses. But the government factory inspector has certain overriding powers. Should he find the accommodation insufficient or insanitary, he can serve notice on the local authority to exercise its function, and if no action be taken he can himself proceed to get the complaint rectified and charge his costs to the local authority. It is scarcely possible, however, for him to do much toward enforcing the adoption of a really satisfactory system. A Secretary of State's Order of 1903 specifies one sanitary convenience for every twenty-five females, also one for every twenty-five males up to 100 and, if sufficient urinal accommodation be provided, one additional convenience for every forty males over that number. If more than 500 males are employed, and the district factory inspector certifies that proper supervision and control is exercised and that

there is sufficient urinal accommodation, a proportion of one convenience to sixty workmen is allowed. These conveniences must be well lighted and well ventilated, and must be kept clean; they must not communicate with any workroom except through a ventilated space; they must be under cover, partitioned, and, in the case of those provided for females, must have doors and fastenings; they must be conveniently accessible; where both sexes are employed, the provision for each sex must be so placed or so screened as not to be visible from any part where persons of the opposite sex are working, even though the door be open; if conveniences for the two sexes adjoin, the approaches must be separate. Unfortunately this very excellent Order of the Home Office applies only where the local authority has not adopted the Public Health Acts Amendment Act of 1890, and as practically all such bodies have now adopted this Act, they, and not the inspector, have the power to fix the standard. As standards are not at all uniform with different local authorities, the ways and means for securing proper sanitary accommodation in factories, from an industrial hygiene point of view, cannot be considered as satisfactory. Some local authorities have adopted the water carriage system and converted all the older types of closet to conform with this, while other authorities have not insisted upon water carriage and allow factories as well as houses still to be fitted with earth closets and privies. Thus, in spite of his overriding powers, the inspector must bow to local by-laws.

The Annual Reports of the Chief Inspector of Factories furnish plenty of evidence of the lack of uniformity and the general slackness among local authorities in dealing with sanitary conveniences in cotton factories. I will quote a few paragraphs from the Report of 1919 (23), as examples of what is found by inspectors.

Miss Constance Smith says, "The irregularities found were discouragingly numerous, and in many cases of a serious character. They reveal a standard of sanitary accommodation which is a reproach to occupiers and local authority alike. . . . . When a borough tolerates thousands of pail closets in the homes of its citizens, it is hardly surprising to find some of its industrial establishments equipped only with the same primitive form of sanitary convenience. . . . . While the general level of sanitary accommodation was in a good many places found low, it sank lowest in certain purely cotton towns." Miss Keely says, "One of the most unpleasant systems consisted of a set of conveniences on different floors of a mill communicating with an insufficiently covered cesspool outside the mill wall. These were supposed to be flushed by buckets of water, but this was apparently frequently neglected. In another mill tub closets opened directly into the workrooms." Miss Andrew says, "In another mill, where a model canteen and a club house had been opened, every convenience in the spinning department ventilated directly into the workroom and in the weaving shed there were no doors to the conveniences. A mill with beautifully tiled staircase and passages and a model gassing room had conveniences without light, without ventilation and without doors."

The Report for 1925 (17) states that some progress is being made but mentions that a special investigation carried out in one large town showed that of fifty-four cotton mills only twenty-six possessed satisfactory sanitary accommodation.

One can scarcely blame the medical officer of health for these insanitary conveniences; it is the system of democratic control by the ratepayers' representatives which is at fault. There is reasonable expectation, however, that this somewhat chaotic system of dual control will not last much longer, but will be forced to give place to a universal standard for all factories. The water-closet system is the proper one for cotton factories, and in spinning mills accommodation should be provided for the two sexes on each floor. The absence of a public sewer is no deterrent in these days of the septic tank and filter bed.

Cloakrooms.—The Cotton Cloth Factories Regulations of 1911 order the provision of cloakrooms for all humid sheds erected after Feb. 2, 1898, and that is the only legal obligation in the matter so far as concerns the cotton industry. As it does not extend to dry sheds and spinning mills, it can be well understood why none of these have so far provided anything beyond lockers in the workrooms themselves.

Clean, well-ventilated cloakrooms, with hygienic metal lockers, perforated at the top and the bottom and in front, and capable of being sufficiently heated to dry wet clothing are a necessity for cotton mills. The particular need in these factories is due to the fact that the high temperature of spinning and doubling rooms and the excessive moisture in weaving sheds necessitate some change of clothing, and for the same reason it would certainly be inadvisable to have the changing room far away from the workroom. With spinning mills this means accommodation on each floor, and the duplication of this where the two sexes work together. These separate rooms attached to the spinning and doubling departments should be fitted with washbowls supplied with hot and cold water, foot baths, and bathroom, and should have the sanitary conveniences attached. In other departments, including weaving, the fitments need not be quite so extensive. There should be some one in charge of each cloakroom to make sure that none of the fittings are badly used, to see to the observance of Regulations, and to keep the room, with the attached lavatories, baths, and sanitary conveniences, in a cleanly condition.

The present practice of changing clothes behind mule creels is certainly objectionable from the hygienic point of view, and, where the two sexes work together in the same room, from the moral aspect as well. There is not the slightest doubt that full provision of the accommodation described would materially diminish the proved excessive liability of cotton operatives to contract catarrhal colds, tonsillitis, rheumatism, and bronchitis.

The provision of the cloakrooms and their accessories would not increase the cost of new mills to any material extent, and the owners of old mills should seriously consider what can be done to make the necessary provision. Indeed any reasonable outlay in this direction would bring a valuable return in the increased health and com-

fort of the operatives, and in the consequent improvement in working capacity.

Personal Cleanliness.—All the Lancashire cotton towns are fairly well provided with public baths, and the prospective operative during his or her school career is well trained in the matter of bodily cleanliness by being compelled to join a bath parade once every week. This regular cleansing is kept up to some extent after entering the mill, but, on account of the cost, possibly, the general tendency is to let it lapse as time goes on. Where welfare supervisors are in evidence this tendency may be checked to a considerable extent, and a favorite method is to promote interest in swimming by forming clubs and getting up inter-mill competitions. The older hands, unless they have baths at home, appear to be very irregular with their bodily washing.

The greatest need for frequent baths arises among those working in the spinning and doubling rooms. They necessarily perspire a great deal if not always visibly, and during their work they dispense with shoes and stockings. These operatives should each have two baths a week, and those in the other parts of the mill should not be without the weekly complete wash. The only way to cater for the older workers who have no home facilities is to provide a certain number of bathrooms or douches at the mill, and this solution is being taken seriously in hand by some mill owners. As I have previously stated, all mills should have sufficient and suitable lavatory accommodation, which for spinning should include foot baths or troughs for cleansing the feet and legs. As a preventive of dirty feet, as well as a protection against splinter wounds, some firms have adopted canvas shoes with hemp soles for workers in spinning and doubling rooms.

Miscellaneous Factors

Apart from those definite conditions associated with the industry which have already been dealt with, there are some other factors which, on occasion, react on the operative and produce certain specific lesions. The factors I propose to deal with are contact with lubricating oil, septic infection, and skin irritation.

Lubricating Oil.—In the course of cleaning their machines at the week-end, most cotton operatives come into close contact with oily gears and get their hands and arms, and sometimes other exposed parts of the body, fairly well soiled in the process. Mule spinners and piecers have admittedly a particularly dirty task when cleaning the headstock gears, but, quite apart from this weekly exposure to oil, it has recently been conclusively demonstrated that they are subjected twice each day to a definite impregnation of certain parts of their clothing with this material. We now know that this impregnation is the principal factor in the causation of a form of skin cancer to which mule spinners have been particularly susceptible during recent years, and which is popularly termed "mule spinners' cancer."

The cotton trade and the medical profession were first awakened to the fact that mule spinners were subject to this disease by an article contributed to the *British Medical Journal* of Nov. 18, 1922, by two Manchester surgeons, Mr. A. H. Southam and

Mr. S. R. Wilson (30), in which it was stated that of 141 patients with epithelioma of the scrotum attending the Manchester Infirmary, during a period of twenty years, sixty-nine were mule spinners. Since then a considerable amount of information has been collected by the Factory Department, and published in the Annual Reports of the Chief Inspector for the years 1923 to 1925, inclusive (24) (28) (17), but the most complete account of the association of mule spinners with this disease is contained in the Report of the Special Committee of the Home Office published in 1926 (31). As I gave evidence before this Committee and as my facts and views have been pooled with those of other witnesses to form material for the Report, I think that perhaps the best method I can adopt in dealing with this phase of my subject is to review the essential facts and findings to be found in this publication. I summarized the position for the International Labour Office in 1924, and I am glad to note that there is little disparity between the Committee's findings and the views which I then expressed. The Report, however, provides much more information than was available two years ago and its recommendations have the weight of authority behind them.

The Committee was able to trace 539 cases, Oldham and Blackburn combined, with a proportion of 9,105 mule spinners to the total of 22,699, accounting for more than half the number (282), and Bolton with 3,900 spinners accounting for 80. The region involved was not invariably the scrotum, as first suggested, for 89 cases had other parts of the skin affected; the site being head and neck in 31, upper limbs in 23, lower limbs in 11, groin and trunk in 6, and penis in 13; there were multiple lesions in leg and arm (1), forearm and ear (1), ear and scrotum (1), and penis and scrotum (2). In view of the fact that recent notifications showed 26.5 per cent. of the total occurring at other sites than the scrotum and that recent mortality figures provided by the Registrar-General showed 23.3 per cent. for these other parts of the skin, it would appear that 89 could scarcely represent a true proportion of the gross total. In other words, the scrotum has nothing like the monopoly of site originally credited to it.

Only 4.4 per cent. of the persons affected were under 35 years of age; the age at which the disease appears to be most prevalent is 55 years, and the average age of incidence works out at 52.4 years. In only 2.6 per cent. was the duration of employment, prior to the commencement of the disease, less than twenty years, the average period being forty years, the shortest ten years, and the longest sixty-three years. In 79 instances the disease broke out among ex-spinners after periods of from one to thirty years had elapsed from the time of leaving the cotton industry.

The growth usually selects the left side of the scrotum and is preceded, in most cases, by a warty formation, which may exist for several years before becoming cancerous. These warts may appear singly or there may be several, they may disappear and recur, and either one or more may become malignant. After a varying period they begin to enlarge, sometimes rapidly; then they break down and

exhibit the typical ulcerating surface. In some few cases there may be no preliminary wart. One case that I saw myself started with a hard, parchmenty patch in the skin, the outer surface of which afterward exfoliated and left an ulcerating surface. The inguinal glands become affected and the disease may spread to internal organs. In situations other than the scrotum the progress is said to be slower and the growth more amenable to treatment.

With regard to causation, it has been proved by Dr. A. Leitch (32) that soot, tars, pitch, shale oils, and mineral oils are capable of producing cancerous growths on the skin of certain animals when applied for a prolonged period. Continental observers have reported cases of epithelioma, mostly scrotal, occurring in the preparation of paraffin oils from the distillation of lignite and in petroleum refineries. Dr. Scott (33) of Broxburn has had experience of sixty-five cases of the disease among the workers in the Scottish shale oil industry. I have myself had experience of a case where the man had been occupied for some years in mixing mineral lubricating oils. The exact factor in these several products which causes the disease has not up to the present been discovered, but there is now no doubt that the materials contain something that has carcinogenic properties. The Committee is at any rate quite convinced that without the mineral oil there would be no spinners' cancer. The history of spindle oil in this country has been well traced. In the first half of the nineteenth century animal oils such as sperm, neats' foot, and lard oil were used for lubricating spindles; after 1850 these were blended with mineral oils, and in 1875 the latter preponderated. The history of spinners' cancer coincides exceedingly well with this change in the character of lubricating oil, the earliest diagnosed case to be traced occurring in 1887, which would be thirty-five to thirty-seven years after the introduction of mineral oil for spindles, or twelve to fifteen years after this became a principal component.

The spindles are about 18 inches in length and are placed $1\frac{1}{8}$ to $1\frac{3}{5}$ inches apart, along the front of the mule carriage; the bottom ends are placed in bearings, known as footsteps, fitted on to a rail, additional support being afforded, about 8 inches from the points, by a bolster rail. The former are oiled daily or at longer intervals according to the speed at which the spindles revolve; the bolster plate bearings are oiled at the commencement of every morning and afternoon spell. The bolster is usually a grooved brass plate perforated with plain bearings; when oiling, the spinner runs the spout of his oil can along this groove. When the mule is started, the oil comes into contact with the spindles, which run at the rate of 8,000 to 11,000 revolutions a minute while the carriage is moving outward, and is thrown off as a fine spray for about two minutes. As the spindles are tilted away from the spinner, he gets the full benefit of this spray as he moves backward from the advancing carriage, the result being that a distinct oily patch is to be seen on his trousers at the level of the pubes. If he wears a shirt, this also gets oily from contact with the trousers. Oil is also thrown out from the footsteps, but as this part of the carriage is

usually covered the spinner is protected; he does, however, get some drippings on his trousers as his legs come into contact with the lower part of the carriage front.

Several possible contributory causes of the disease are mentioned. Mechanical friction against the faller bar, which runs the length of the mule carriage in front of the spindles, may cause some irritation of the skin, but my own view is that the scrotum could scarcely be affected in this way as it is the groin region which receives the pressure. The oily scrotum gets much more friction with the upper part of the thigh from constant walking backward and forward, and this friction, together with the prevailing method of forking, may explain the partiality of the growth for the left side. The heat and moisture of spinning rooms, by opening the ducts of the sebaceous glands, probably facilitate the entrance of oil into these channels and the production of irritation. It is for this reason that a more rigorous personal cleanliness is recommended. The Committee did not agree with the theory that the dye in colored overalls could be responsible. A real objection to blue overalls is that those who have taken to them change into clean ones only once a fortnight, instead of weekly as is the usual practice with white trousers, and thus are exposed to a bigger dose of oil. I have good assurance that the dye is harmless to the wearer.

It is concluded that the remedy for the disease lies either in the provision of innocuous oils or in preventing contamination. The first I do not regard as attainable until the actual carcinogenic factor is known and a method of removal discovered. I am quite sure that mineral oils have come to stay. The second solution is, I believe, both practical and practicable. I cannot conceive for a moment that a class of engineers famous for its conceptions of the most intricate self-acting motions ever adapted to any mechanical contrivance is going to be nonplused by a spindle bearing. The waste of oil through the spindles has been recognized for very many years, and methods have been contrived from time to time to obviate this. An old "gaiter" tells me that the device mentioned by the Committee, consisting of a trough fitted with a long pad and communicating with each bearing, was in use forty years ago and was lidded to keep out the fluff. Another device occasionally used is on the lines of the second mentioned by the Committee and has oscillating bearings with pads between the spindles and the trough; in addition the footsteps are fitted with a perforated cover. The simple trough in the top of the bolster plate fronting the spindles, which communicates directly with the bearings by small holes and is favorably mentioned, should, I think, be lidded to keep away the fluffy dust. Hitherto the cost of adoption has been regarded as greater than the saving to be effected, but now, in view of compensation demands, this can scarcely be the case. One therefore cannot but agree that "it is most desirable that manufacturers of spinning machinery should attempt in the future to provide new mules with a non-splash type of bearing," and I would suggest that this should also be done when bolsters and footsteps are changed on account of wear. As

a temporary measure it is thought that a felt splash guard, fixed to the inside of the door and projecting about $\frac{5}{8}$ inch above the level of the bolster plate, would be beneficial and would not interfere with oiling or doffing. It is also recommended that series of experiments in splash prevention should be arranged jointly by the Master Spinners' Federation and the Operatives' Association. The Committee also strongly condemns the practice of putting oily waste or the oil can in a trouser pocket.

The contention that it is essential for spinners to cleanse the skin regularly with soap and water is strongly supported. There is no doubt that so far as the general body surface is concerned cleanliness is a forgotten virtue with a vast number of spinners, in spite of the availability and cheapness of public baths. I agree that the absolute necessity for reformation in this direction should be brought home to those concerned, and I would also suggest the advisability of encouraging employers to arrange suitable washing facilities where they have the necessary space available.

It is quite plain, however, that, whatever is done in the directions indicated, there must necessarily be a considerable body of men already infected, from which during the next thirty years a constant if not very large stream of fresh cases will be drawn, and that these cases should receive prompt treatment is an axiom in the dealing with epithelioma. Obviously early detection must precede early treatment and so the Committee very properly recommends medical examination every four months of all spinners over 30 years of age. Judging from previous experience with patent fuel makers, no voluntary arrangement for such examinations is at all likely to prove a success; the suggestion is therefore made that, unless this view is negatived after a twelve months' trial, compulsory examinations should be instituted.

Septic Infection.—It is very well known that cotton operatives are particularly liable to develop a localized blood poisoning after the infliction of the most trivial injuries. This susceptibility is commonly attributed to constitutional weakness, and this explanation may be true to a certain extent where nutrition is obviously below par, but personally I believe that the fault is, in the main, quite local. Prosser White insists that the human skin is normally infested with myriads of bacteria, mostly streptococci and staphylococci, and that these infect a wound at the time the injury is inflicted. One has no difficulty in understanding how this state of skin infectivity can be much intensified under the particularly favorable conditions provided for bacterial growth by the hot, moist atmosphere of spinning rooms, the activity of the sweat glands, and the unwashed skin of so many of the operatives. Apart from injury, one meets with a considerable amount of folliculitis producing raised pimples, either with or without a suppurating head, and the occurrence of small boils is quite common. I remember reading at the time of the Russo-Japanese War that when the Japanese fleet was getting ready for action all the sailors bathed and put on clean cotton clothes for the purpose of preventing any septic infection of possible wounds. If such

a practice were more common in cotton mills there would certainly be less blood poisoning.

Most of the infections are associated with contusions, small abrasions, contused wounds, splinter wounds, and cracks on the fingers. If soaked with iodine at the time of infliction these injuries almost invariably do well, but when the infected cracks are presented to the first aid attendant there is usually sufficient inflammation to demand fomentations. First aid equipments are, of course, compulsory in all factories, but these are not of much value unless properly and rationally utilized. Every cotton factory really requires a well fitted up ambulance room and a very competent first aid attendant; there are so many foot injuries and such dirty feet in spinning rooms that I have found a foot bath to be one of the most valuable accessories to such a department. The combination of first aid with welfare has in my experience been very effective in reducing the incidence of septic infection.

Skin Irritation.—Apart from the effects of mineral oil and the septic conditions mentioned, cotton operatives experience very little liability to dermatitis. The affections of this nature which have been noticed are, however, worthy of some consideration.

In picking away the cotton from the jute covers of the bales the external surface of the finger ends suffers from friction, and sores frequently develop to a sufficient extent to require removal of the sufferer from this particular work. Prosser White (34) describes a number of cases of mold rash which occurred mainly among workers handling raw cotton. He also mentions that band jobbers, the youths who manipulate the spindle bands and fix them on the tin rollers of spinning frames, are troubled with excoriations on the ulnar edge of the hand and the little finger; that doffers suffer from a species of beat hand as a result of having to use force in removing stiff bobbins from the spindles; that roving frame tenters are subject to callosities on the hand from the practice of taking the run off the flyers after stopping the machine. The same author has investigated dermatitis occurring among those engaged in conditioning cops by immersing them in water, by spraying them, or by placing them between damp cloths, and has found the condition to be due to the addition of formalin as a preventive of mildew. He also found that certain winders suffered from venous stasis in the hands, marked terminal anesthesia in the fingers, and skin sores resulting from contact with bobbins of yarn which had been steeped in a solution of potash alum. He further gives an interesting account of certain dangers arising in weaving sheds from the use of warp size to which chloride of zinc and arsenic had, on separate occasions, been added as preservatives. The first caused burns through splashes from the sizing machine, and the second produced among the weavers a most harassing dermatitis. Weavers have also suffered from rashes caused by handling dyed weft from which the lime had not been thoroughly removed.

I have frequently come across a dermatitis on the ulnar edge of the left hand among "knotters" who twist up hanks of damped yarn for

parceling. The tying up of parcels of yarn causes alternate thickening of the skin and smooth furrows on the ulnar aspect of the right hand. Clearer winders are subject to thickening of the skin and deep cracks on the first finger of the right hand as a result of using this digit to guide the yarn into the clearer slot after piecing; this is obviated by letting the yarn run over the scissors used for cutting the ends. I have seen a number of cases of skin irritation with some cellulitis from the use of patent knotters for piecing broken yarns. This apparatus is a species of flat metal box, weighing about $4\frac{1}{2}$ ounces, which is attached to the palm of the left hand by a strap passing over its dorsal surface. The most expensive of these, costing £10, will tie a perfect weavers' knot and cut the ends off short. The broken ends are gathered by the winder, placed in a groove in the box, and the pressing of a lever with the left thumb does the rest. There is pressure and some friction on the radial edge of the palm, but usually any irritation disappears after the knotter has been in use for a few days. In some instances, however, the inflammation progresses, and I have usually found the best policy under such circumstance is to let the worker go back to hand knotting. In one instance a ganglion developed on the metacarpophalangeal joint of the left index finger and rendered the using of the knotter impossible.

I have seen a few cases of housemaids' knee among doffers, which have probably been due to the practice of releasing the bobbin from the spindle by pressing the spring catch with the right knee. In the ordinary way of doing this, however, the doubled sheet of brown paper, pinned on the skirt as a protection from oil, acts as an efficient pad to the knee. In order to get sufficient purchase against the spring, the doffer places the right foot against the inside of the left leg, and this action, if wearing shoes or slippers, sometimes produces a painful spot on the shin. This appears to constitute one reason why doffers prefer to work with their feet bare.

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BOOK REVIEW

Principles of Employment Psychology. By *Harold Ernest Burtt*, Ph.D., Professor of Psychology, Ohio State University. Cloth. Pp. 568 with appendixes, bibliography, and index. Boston, New York, Chicago, San Francisco: Houghton Mifflin Company, 1926.

There have been a number of new books on the subject of employment psychology but in the opinion of the reviewer no one of them equals, when all is considered, this present work by Dr. Burtt. He includes in his book much of what may be found in other books but in a more interesting manner and with a little better appreciation of the value of the various topics. The main virtue of the book is that it does not insist upon a mechanistic use of psychologic tests or the interpretation of test scores. The author appreciates the fact that many variables, outside of those measured by the tests and treated statistically, are of great importance in the selection and guidance of workers. He also is aware that one must often make many allowances when interpreting and applying test scores. He discusses the philosophy of employment psychologic methods, expresses his attitude toward the rationale of their use, and feels keenly that the purpose for which psychologic methods are employed is of as great importance as the methods themselves.

To one interested in mental hygiene this book of Dr. Burtt's is indeed welcome and the social breadth of the author's point of view is encouraging. He says: "The broad movement to study man has just begun Psychology is now playing an increasing rôle in the school, in the clinic, in the advertising agency, in the factory, and in the employment office. These problems of life adjustment are coming more and more to the front. The last century was characterized by tremendous advances in the natural sciences and in the technologies. The present one bids fair to be an era for human engineering. The psychologist's ideal is to have every one provided with the opportunity to do that particular part of the world's work for which he is best adapted and in which he is most interested. When this ideal is achieved, the world will be a happier place for all of us."—*Henry B. Elkind.*